

TO: Utah Air Quality Board

FROM: Utah Physicians for Healthy Environment

DATE: March 5, 2008

SUBJECT: Response to Steven Packham's Presentation on February 6, 2008 to the Air Quality Board.

The Utah Physicians for a Healthy Environment thank you for the opportunity to respond to the presentation last month by DAQ toxicologist Steve Pakham.

In the last 60 years government and industry have often steam rolled public health in pursuit of certain agendas. Along the way, a few people have stood in their path, some at considerable personal risk. (Slide) People like J. Robert Oppenheimer, the father of the atomic bomb, pleaded with the Atomic Energy Commission not to pursue the hydrogen bomb and embark on the hundreds of nuclear tests in Nevada that ultimately killed thousands of Utahns. Because of his overriding concern for public health, in the era of McCarthyism, he was accused of disloyalty, if not treason, and in a highly publicized hearing he was stripped of his government oversight position and security clearance. (Slide) Rachael Carson started the modern environmental movement with the publishing of Silent Spring and is still reviled and attacked by the chemical industry 44 years after her death.

(Slide) This is Dr. Gordon Mcleod, the head of the Dept. of Health in Pennsylvania in 1979 when the 3 mile island nuclear accident occurred. He pleaded with the governor to evacuate pregnant women and young children from the area. For days his pleas were ignored, the governor called him an alarmist and he was eventually fired. By the time the governor did call for an evacuation the damage had been done. Over the next several months the infant mortality rate in the northeast rose substantially, and statistically over 430 infants died as a result.

(Slide) In Utah, Dr. Arden Pope, at BYU is recognized as one of the world's premier researchers in the field of public health consequences of air pollution. In fact his research could be considered the foundation of the EPA's national ambient air quality standards. His name and two of his articles were used by Mr. Pakham. He almost lost his job in the late 1980s because his research cast a shadow on a very prominent Utah County industry. Again, in the 1990s he was viciously attacked by industry trade organizations who called his research junk science and boldly stated he had lost his credibility. He was obviously later vindicated.

One of the members of UPHE, Dr. Richard Kanner, professor of medicine at the U. of Utah was forced to resign as chairman of the AQB in 1997 when he levied a fine on Magcorp, one of the worse polluters in the nation. With this kind of history we knew from the start that UPHE would face resistance from defenders of the status quo.

The theme of last month's presentation was to scientifically undermine, quote "statements comparing air pollution to smoking five to ten cigarettes per day that have recently appeared in some Utah newspapers."

The presenter offered these concerns as his motivation. (Slide) "Comparisons such as this grossly minimize the serious health effects of smoking." We feel this is a bizarre take on our message suggesting that the public has a fixed capacity to feel concerned. More concern about

air pollution in his mind somehow requires less concern about smoking. However, we have seen no indication that anyone in our audiences have reacted this way. I don't recall a single person lighting up a cigarette after attending one of our lectures.

I have heard hundreds of comments like, "What can I do to help clean up our air?" (Slide) Apparently the author of this presentation thinks that for people to come away with this attitude is somehow "counterproductive to finding a solution." Does anyone really see a danger that Utah will become overzealous about protecting public health? If that happens then we truly will have worked a miracle.

Our statement comparing cigarette smoking to air pollution is a metaphor, a deliberate attempt to draw attention to the issue and it has never been used in the same way as one would use a scientific equation. In the exact same way public service campaigns are frequently crafted to be emotionally charged to draw attention to issues like smoking, drug use, and impaired driving, they are not intended to be scientific equations.

(Slide) Does this disturbing picture of an exophytic throat cancer belong in an anti-smoking campaign? Few smokers ever get this type of cancer so it could be argued that this is an exaggeration and a distortion of real science. I would disagree with anyone who suggests this imagery is counterproductive in an anti-smoking campaign.

(Slide) Does anyone think these kind of disturbing pictures of fatal auto accidents belong in driver's education material for teenagers? Very few drivers will be involved in these horrific accidents so is it scientifically pure to show these pictures to teenagers in an attempt to scare them into cautious driving? Incidentally, more people die of air pollution than die of traffic accidents but they seldom make the nightly news.

(Slide) "This is your brain on drugs" is hardly a scientific description of the consequences of drug usage. Is this kind of imagery counterproductive in curbing drug usage?

Emotionally charged imagery is frequently used for worthy public service campaigns. We think air pollution qualifies as one of those.

Change is currently a popular political buzzword. The whole purpose of our presentations is to motivate people to change their behavior and demand change in government policy. Effective public speaking is seldom a compilation of charts and graphs and scientific equations, it is the inspirational expression of ideas. Metaphors and imagery are common tools used to sell ideas, and we are selling the idea that all of us suffer from poor air quality, especially our children, that we can and must urgently do something about it and we are unapologetic in doing so.

Most importantly let us now compare the facts and science of our presentation and our use of this metaphor and compare it to the science presented last month. (Slide) Our presentation is based on over two thousand research articles published in the world wide main stream medical literature in just the last ten years alone. (Slide) Our claims also come from public position statements by and review articles from the American Lung Association, the American Heart Association, the American Academy of Pediatrics, the American Thoracic Society, and the American Medical Association just to name a few. Our recommendations of policy changes such as making our ambient air quality standards more strict are identical to policy positions of these esteemed organizations and others like the World Health Organization and the CASAC, the nationally renowned scientific advisory panel to the EPA.

First let's discuss clinical end points.

(Slide) In Mr. Packham's presentation he showed you a slide where in he states, "Utah air might be estimated to shorten life by 3.5 days." Let me read to you a quote from the American Heart Association, one of the premier medical organizations of the world. "Some research has estimated that people living in the most polluted U.S. cities could lose between 1.8 and 3.1 years because of exposure to chronic air pollution." From the American Lung Association's web site and I quote, "Chronic exposure to particle pollution can shorten your life by one to three years." (Slide) We have used the figure of 2 years, and the Wasatch Front consistently ranks in the top ten worst cities in the country for acute spikes in air pollution. Remember that this statement by the ALA only refers to particulate matter air pollution. Other components of air pollution like ozone and HAPs will add to those mortality rates and adverse clinical outcomes. So Mr. Pakham is stating that the impact of Utah air pollution is 1/240 of that of claimed by everyone else.

(Slide) Mr. Pakham acknowledges that a smoking habit of a pack a day during adulthood will shorten the life span of the average person 8 years. 2 years is 25% of 8 years. 25% of a pack a day is 5 cigarettes. This is a very simple explanation about why we are on solid scientific ground for making that claim. We have never made the claim that air pollution is equivalent to smoking 10 cigarettes a day as alluded to by Mr. Pakham. It is possible that other people have inadvertently embellished our message and our data.

We however, have not. We also have acknowledged all along that 5 cigarettes a day are not exactly equal to 25% of the impact of smoking a pack day because the first 5 cigarettes probably do more damage than the next five.

(Slide) One of the most important recently published research papers on PM was published a year ago in the New England Journal of Medicine, arguably the most prestigious medical journal in the world. Studying 66,000 women for over 6 years the researchers found that for every increase of 10 mcg/cm³ of PM 2.5 in long term exposure, there was a corresponding increase of 76% in the risk of death from cardiovascular disease. Compare that to this statement from the health web site sponsored by the government of Victoria and the Heart Foundation of Australia. "Smokers have a 70% greater risk of death from coronary heart disease than non-smokers."

Mr. Pakham's calculations for PM exposure are based on an annual average of 12 ug/cm³. No where does he take into account the fact that acute spikes in air pollution (i.e. the inversions for which we are infamous) have their own, additional contribution to mortality beyond that from the chronic exposure of an annual average.

(Slide) The famous killer smog in London of 1952 left 4,000 people dead in a matter of five days and ultimately killed 12,000 people, yet the annual average PM for that year was probably little different than normal.

One epidemiologic study of children with asthma found that changes in symptoms and lung function were more strongly correlated with one hour peaks in PM matter than with 24 hour averages. Short term increases in ozone are also associated with increased mortality in the week afterwards. Numerous studies document that mortality rates increase for as long as 30 days after an acute spike in air pollution that may only last several hours.

Studies of pathophysiology demonstrate parallel results. (Slide) Patients exposed to typical urban levels of diesel exhaust for only one hour, experience important systemic and adverse vascular effects for at least 24 hours after exposure.

(Slide)

His reasoning also ignores the fact that annual averages for a downtown monitoring station may have little relevance to air pollution concentrations even a few miles away. Air pollution concentrates near its sources. What is emerging as the most dangerous component of particulate matter is called ultrafine which is much smaller than PM_{2.5}, i.e. .1 μ g in diameter. Following the principle that smaller particles can penetrate more deeply into the lung and the evidence that they can enter the body without even going through the lungs these particles are now being viewed as even more dangerous than their larger counterparts. A study published in the Journal of the Air and Waste Management Assoc. in 2002, discovered that concentrations of ultrafine PM can be thirty times higher near freeways and busy intersections. We don't even monitor for ultrafine concentrations.

Let me read to you the first few sentences of the abstract of an article published a month ago in Circulation Research, a journal sponsored by the American Heart Association.

"Air pollution is associated with significant adverse health effects, including increased cardiovascular morbidity and mortality. Exposure to PM_{2.5}, increases ischemic cardiovascular events and promotes atherosclerosis. Moreover, there is increasing evidence that the smallest pollutant particles pose the greatest danger because of their high content of organic chemicals and prooxidative potential."

In fact the assumption Mr. Pakham makes that PM absorbed by smoking machines can be linearly related to clinical outcomes in human beings breaks down for several reasons.

(Slide) As illustrated by the studies of ultrafine PM, two identical weights of PM (one from smoking and one from air pollution) can have dramatically different toxicities if one is composed of larger particles compared to smaller particles. Numerous studies suggest for example that the chemical composition and surface areas of the particles are much more correlated to toxicity than particle mass.

Mr. Pakham's assumption that "a linear dose/ response based solely on total weight of PM breathed into the body" is also contradicted by the National Cancer Institute which states, "The only way to reduce a smoker's risk, and the risk to others, is to stop smoking completely." And in fact studies of smokers who reduce their smoking by 50% do not show a reduction in their risk for premature death. There are many studies that demonstrate a few cigarettes a day have almost as much physiologic consequence as many cigarettes a day.

(Slide) As an aside let me state that in fact in our presentations usually include this phrase "In the same way there is no safe number of cigarettes one can smoke there is no safe level of air pollution once can breathe." How can this possibly be construed as minimizing the health impacts of smoking?

(Slide)

For Mr. Pakham to draw any clinical conclusions from his smoking machines contradicts his own references. (Slide) Let me read to you some quotes from one of the articles that he sighted to make his case. "The main reason for setting up the smoking machine method was... to allow comparison of different products on the same basis." In other words it was never intended to simulate the physiology of smoking's effect on the human body, it was only developed to compare cigarette brands with each other. "There are marked variations between the smoking

habits adopted by individual smokers.... and even within the same smoker....It seems unrealistic to talk of representing human smoking by using a machine....The smoking machine is, therefore, unable to provide an accurate reflection of the amount of any smoke constituent which a given smoker may obtain.....many smokers obtain very little smoke from their cigarettes.”

The author goes on to talk about how there is so much variation in how people may or may not damage the filters with their lips and how they process the smoke and how long they inhale, the shape of the puffs etc, etc, etc, and finally the author concludes that a smoking “machine cannot be related directly to human smoking.” Users of pipe tobacco and cigars have virtually the same risk for lung cancer that cigarette smokers do and yet the amount of PM they inhale is much less and not simulated by Mr. Pakham’s smoking machines.

(Slide)

Reinforcing this author is a fact sheet issued by the National Cancer Institute and the position of the World Health Organization which state that smoking machines do not tell how much tar and nicotine may enter the body. Professor Lynn Kozolowski, head of the Dept. of Biobehavioral Health at Penn State likened the smoking machines to trying to measure caloric intake by inventing an eating machine. In other words all Mr. Pakham’s assumptions about human exposure to PM based on smoking machines are invalid.

In the area of clinical outcomes, we quote from the American Lung Association:

(Slide) “Short-term increases in particle pollution have been linked to:

Death from respiratory and cardiovascular causes, including strokes. Increased numbers of heart attacks, especially among the elderly and In people with heart conditions. Inflammation of lung tissue in young, healthy adults. Increased emergency room visits for patients suffering from acute Respiratory ailments. Increased hospitalizations for asthma among children. Increased severity of asthma attacks in children.”

(Slide) Year-round exposure to particle pollution has been linked to:

“Increased asthma hospitalization for children hospitalization for children. Slowed lung function growth in children and teenagers. Significant damage to the small airways of the lungs. Increased risk of dying from lung cancer. Increased risk of death from cardiovascular disease.”

These are all clinical end points similar to smoking and do not include additional outcomes from ozone and HAPs.

(Slide) We have also made claims about the toxicity of CCW stockpiles near coal power plants. Mr. Pakham stated that nicotine and cancer put cigarettes in a league of their own. Let me read to you a statement from the EPA’s Human Health and Ecological Risk Assessment. Cancer risk associated with exposure to CCW constituents are as high as the risks of smoking a pack of cigarettes per day.

Next let’s discuss gross pathology:

The American Lung Association’s web site makes reference to a study of autopsied lungs from Mexico City, known for its high levels of air pollution and compares them to lungs from Vancouver where there is very little air pollution. I quote from their summary of this study.

(Slide) “The study demonstrates that particle pollution penetrates into and is retained in the walls of small airways. The resulting damage to the lungs was similar to that found in the lungs of cigarette smokers.”

Build up of atherosclerotic plaque in the arteries to the brain is greater in subjects living in communities with higher PM_{2.5} concentrations similar to that found in smokers.

Next let's discuss pathophysiology:

(Slide) Let me quote from a review article written by Dr. Pope and Dr. Doug Dockery one of his well respected colleagues. After citing numerous articles on the subject they made this statement.

“With regard to biological plausibility, it has also been shown that low-level PM exposure from secondhand smoke increases platelet activation and promotes an inflammatory response and atherosclerosis, even at exposure to secondhand smoke as low as one cigarette per day. These findings suggest that urban ambient PM and PM from cigarette smoke may invoke similar pathophysiological mechanisms related to pulmonary and systemic inflammation and atherosclerosis.”

(Slide) Mr. Pakham's premise assumes that smokers start smoking at age 18 and that breathers of air pollution also start breathing at age 18. Trust me, I am a doctor if you don't start breathing before age 18 then you're going to have serious health problems.

The most important breathing in your entire life occurs in the 18 years before Mr. Pakham's experiment even begins. That is in fact when the most serious damage from air pollution is done.

The American Academy of Pediatrics national policy statement in 2004 stated. “Children are more vulnerable to the adverse effects of air pollution than are adults. 80% of alveoli are formed after birth. During the early postnatal period, the developing lung is highly susceptible to damage after exposure to environmental toxicants.”

The toxicity of the exposure used to be assumed to be related to just the dose of exposure and that is the entire premise of Mr. Pakham's argument. To simply, if a dose of 10 mg of some harmful substance has a certain effect on an adult then a dose of 1mg of the same substance should have a the same effect on a child that weighs one tenth as much. We know now that the whole idea is badly flawed for at least two reasons. The toxicity is also critically related to the timing of exposure such that the same dose of a toxin can have many orders of magnitude greater effect on a fetus at three weeks gestation than the same dose per wt. will have at age two years or twenty years. We also know that the clinical outcomes of exposure can be profoundly different between individuals. In other words the exact same blood levels of a toxic chemical in two people can produce profoundly different results.

(Slide) The toxicity of mercury provides a perfect illustration of both of these points. This is a world famous picture of a Japanese mother and her teenage daughter years after a tragic spill of mercury that contaminated fish that were consumed by thousands of Japanese citizens in Minamata Bay. This woman was pregnant at the time she was exposed. She was virtually unaffected, but the child was born neurologically and permanently devastated primarily because the exposure occurred at a critical stage of neurological development.

Studies by an EPA senior researcher, Dr. Jill James demonstrated that a very high percentage of children with autism have a genetic impairment in their ability to produce glutathione which is

the body's primary metals detoxifier. Exposure to the same doses of mercury in these children, at the same time in the developmental stage of their neurological systems can have dramatically different outcomes because their ability to excrete the mercury is much different.

(Slide) In May of last year two hundred of the worlds leading toxicologists, epidemiologists, pediatricians and environmental scientists gathered for a conference to discuss the issues of children's exposure to environmental contamination and certainly air pollution is one of the main avenues of exposure. They issued this statement. "Human fetuses are programmed for diseases by their early environment....Chemicals can alter gene expression, turning on or off genes that predispose people to disease....Such genetic misfires in the womb may be permanent and all subsequent generations could be at greater risk for disease. There must be a renewed effort to prevent harm....it cannot await more detailed evidence regarding individual toxicants." It is virtually impossible to overstate the impact this can have on public health.

(Slide) Building on this concept a study published last month using thousands of ultrasounds on thousands of pregnant women over a span of ten years showed that women exposed to even modest levels of urban air pollution, primarily from traffic, showed significant intrauterine growth retardation among their fetuses as measured by head and abdominal circumference and femur length. Low birth wt. is associated with a startling array of later on adult morbidities ranging from lower IQs to diabetes, heart disease and cancer. Because these consequences are secondary to the timing of exposure, they defy Mr. Pakham's tunnel vision regarding volume of exposure.

Furthermore, according to the National Cancer Institute, if a person quits smoking by the age of 30 he/or she can reduce their life time risks to the same level as a non-smoker. And that even quitting at age 50 can significantly reduce remaining life time risks.

Because of air pollution's adverse impact on fetuses and children the same cannot be said for air pollution. (Slide) Numerous studies now strongly suggest that the loss of lung function growth experienced by children exposed to air pollution can be permanent and the Southern Calif Children's Health Study reported in Am J Resp Crit Care Med. 162: 1383-90:2000 found that this outcome was greater than for children exposed to environmental tobacco smoke.

Research published in the journal Toxicology, published six months ago measured placental concentrations of toxic heavy metals like Cadmium and Zinc. The authors concluded that , "The study showed that smoking increased Cadmium levels in the placenta and accompanied an increase in placental MT expression immunohistochemically. The effects of exposure to air pollution are equally harmful as smoking related effects."

(Slide) In a study published on Feb. 1, 2008 in the American Journal of Epidemiology, researchers from the Harvard School of Public Health found that children who live in neighborhoods with heavy traffic pollution have lower IQs and score worse on other tests of intelligence and memory than children who breathe cleaner air. The effect of pollution on intelligence was similar to that seen in children whose mothers smoked 10 cigarettes a day while pregnant, or in kids who have been exposed to lead.

The review article by Dr. Pope and Dr. Dockery summarized the effects of air pollution with these statements. "There is ample evidence that PM exposure impacts the health of children. PM exposure in children has been associated with deficits in lung function, lung function growth, increased respiratory illness and symptoms, increased school absences and hospitalizations for respiratory disease. There is also substantial and growing evidence that air pollution is a risk factor for increased mortality in infants and young children....PM exposure is most strongly

associated with post neonatal respiratory mortality. There are a growing number of contemporary studies that have evaluated potential links between air pollution and birth weight, premature birth, fetal growth, intrauterine mortality, and birth defects.” These perinatal complications are identical to those related to pregnant mothers smoking or being exposed to second hand smoke according to the National Cancer Institute.

(Slide) If Mr. Pakham’s calculations were even close to describing the real public health impact of our air pollution, i.e. 1/240 of the mortality impact that we are claiming, then he would likely stand alone in contradicting virtually all medical science on the issue and all major health organizations in the world. He would essentially invalidate the need for any air pollution regulations whatsoever.

Since our inception last year the Utah Physicians for a Healthy Environment have helped spawn a much larger coalition of clean air advocacy groups that joined to form the Utah Clean Air Alliance. Joining this alliance are dozens of health organizations such as the Utah Medical Association, environmental groups like the Sierra Club, citizens groups like the League of Women Voters and the Utah Moms for Clean Air, and business groups like the Park City Board of Realtors whose 1,000 members just last week voted unanimously to join. We now have expertise that draws not only from the medical community but from many other disciplines such as biology, engineering, toxicology, pharmacology, economics, and urban planning. We have scientists in our group who have served in the past on Utah’s air quality board and the air quality boards of other states. But the physicians group continues to play a pivotal role because we provide the scientific foundation for the rest of the coalition.

We are determined to let the public know how their health and that of their children is impacted by air pollution. The medical science is in fact becoming steadily more alarming. This presentation last month was also alarming but for an entirely different reason. It demonstrated an alarming void of medical knowledge within some of the state agencies mandated to protect the health of millions of people. While we do not see this as an indictment of any individuals, including Mr. Pakham, we do see this as clear evidence of a defective system where critical public health decisions are being made by state agencies that have virtually no medical scientists. This system needs to be changed and all Utah citizens have a stake in seeing that happen.

In the meantime within the UPHE and the UCAA hundreds of unpaid volunteers are spending thousands of hours trying to help policy makers better protect our health. Rather than spending time, energy and tax payers money undermining those efforts we think the public is better served by state agencies like the DEQ, DAQ and the AQB accepting our help and expertise. Our children and grandchildren deserve nothing less than our combined best efforts.